ICI magazine

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Front cover
A 1½-ton ingot of titanium is rough-forged by John Townsend, forge manipulator in the New Metals plant of IMI, which is ICI's subsidiary holding company for non-ferrous metal interests. The ingot will be finish-forged and machined by the customer. Titanium alloys combine strength with lightness. Because they will stand up to the temperatures encountered, they are widely used for aero-engine compressor blades, discs and other components. More recently, they have begun to replace steel or aluminium for structural forgings.

Opposite
Removing a titanium billet from the pre-heating furnace to be forged.

Photographs: Otto Karminski

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Editor Francis Odle

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making modern metals

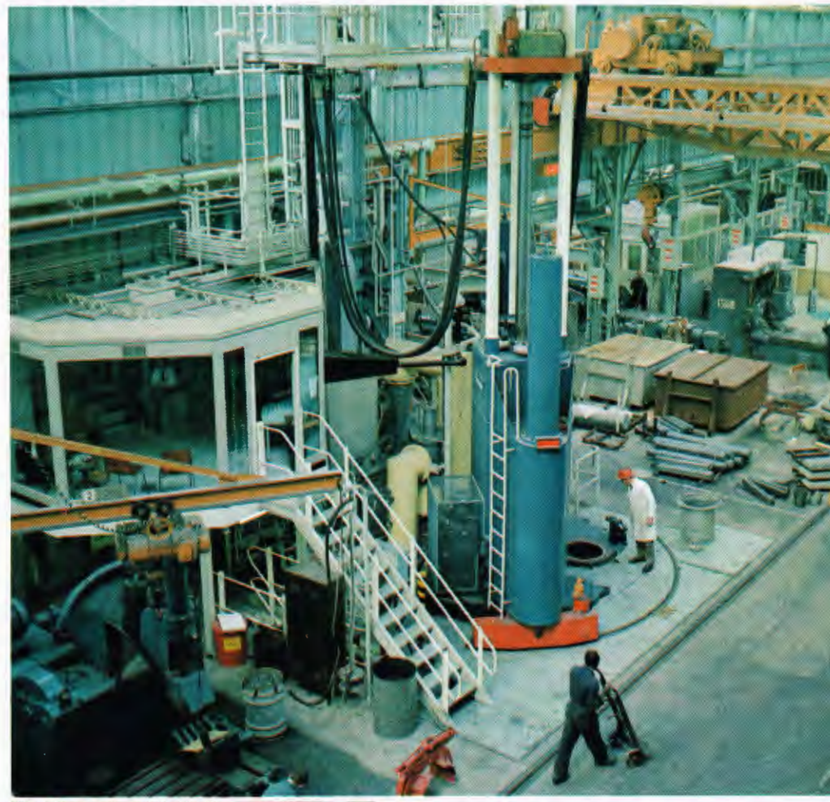
In January 1954, the ICI Magazine published its first article on titanium, sub-titled 'The new metal with big possibilities.' Those possibilities are now realities. Titanium today is not only one of the most important structural metals in aircraft and chemical engineering: it has a rapidly-expanding range of other applications.

Though accurate as far as it went, the 1954 article could hardly have foreseen that the special processing techniques developed for titanium would open up a much wider world of new metals technology – a world of quite exceptional temperatures, precision, and performance.

Imperial Metal Industries Ltd. – who with ICI Mond Division launched the British titanium industry – is Europe's largest producer of new metals. Its titanium alloys, which earned the Queen's Award to Industry in 1967, are making an important contribution to many spectacular new aircraft projects, including the Anglo-French Concorde. Zirconium, the second new metal to achieve commercial status, already goes into products as diverse as nuclear fuel cans and photographic flashbulbs. There is an even more specialised sister-metal, hafnium, so far used only for nuclear reactor control rods. Tantalum, best known in sophisticated electronic applications, shares with titanium and zirconium the property of superlative resistance to chemical attack. Between them, these three metals are solving some of the most recalcitrant corrosion problems facing modern industry.

Newest and perhaps most exciting of all is niobium, now being developed along two separate but equally important lines. On the one hand, niobium is the basis of new alloys specially designed for service at very high temperatures, such as aircraft gas turbine blades operating at up to 1300°C. On the other, an alloy of niobium with titanium has proved the most successful superconducting material yet devised. Developments here are taking IMI superconductors into some of the world's most advanced engineering projects. These may well result in equipment of radically new design, operating at temperatures only a few degrees above zero.

It's 2000°C inside this vacuum-induction furnace used for research into the behaviour of niobium and other modern metals at high temperatures



This melting furnace is the first and only liquid-metal-cooled titanium melting furnace in the world which operates on a production scale. It uses liquid metal (a mixture of sodium and potassium) to cool the crucibles of molten titanium

Forming an electrode: the electrodes used for vacuum-arc melting of titanium are formed by welding together several blocks of compacted titanium granules. IMI Titanium is normally melted into ingots weighing 2000 or 3000 lb. The electrode welder is Barry Stevenson

Nick Molloy, warehouse inspector, applies an ultrasonic flaw test to a large titanium forging

Peter Hodgkinson, managing director, IMI New Metals Division

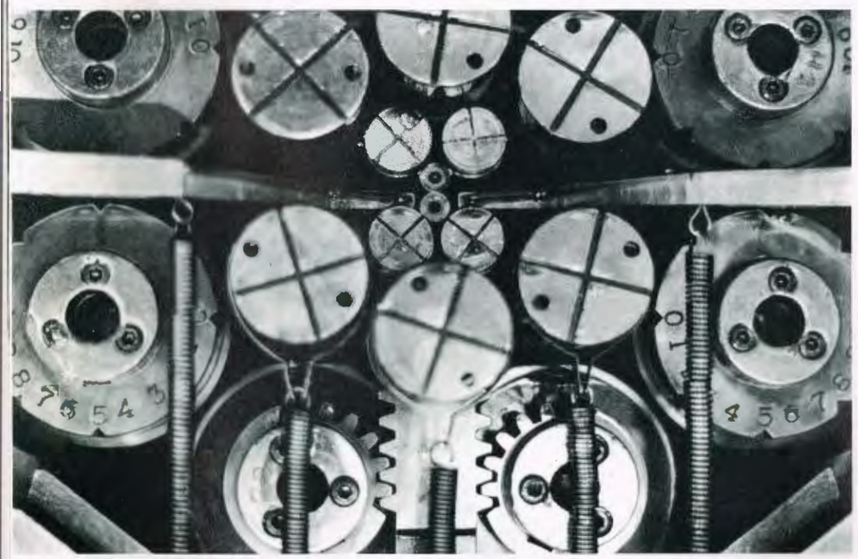
Mrs. Marion McQuillan, technical director

Arthur Busby, production director

John Mountford, sales director

Elfred Lewis, manager, Witton plants, New Metals Division

John Williams, factory manager, titanium plant, Swansea



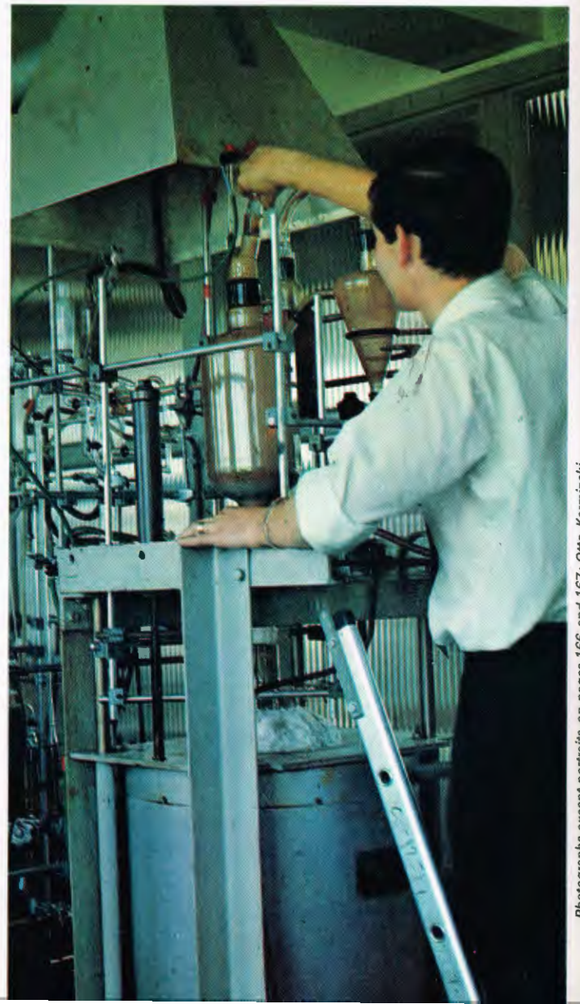
Zirconium foil for photographic flash bulbs is reduced to final thickness on a Sendzimir rolling mill.
The arrangement of small multiple rolls ensures exceptional accuracy and a high-quality finish

This drum of IMI 'Niomax' superconducting tape is part of a 5-ton order for the world's first superconducting motor.
The availability of superconductors – metals which at temperatures near zero offer virtually no electrical resistance – has made possible new concepts in the design of high-field magnets.
Left to right: Frank Farmer, technical officer, special metals; John Woolner, production unit manager, special metals; Tony Barber, section leader, superconducting metals research

'Niomax' conductors consist of a core of niobium/titanium superconducting alloy set in a copper matrix. Make-up of this core ranges from a single rod to numerous fine filaments, according to end use. A final close visual inspection completes the cycle of rigorous quality control at all stages, which guarantees absolute reliability. It is carried out here by Roger Camden, laboratory technician

Pickler Jim Bell puts on protective clothing to deal with the aggressive chemical used to reduce the zirconium nuclear fuel-sheathing tube to its final size

Niobium alloys used in aero engines are exposed to corrosive attack by high-temperature oxidation. Coatings are being developed to protect them, and here the first layer is being put down on the metal by Mike Millward, experimental officer, using a fluidised bed



Photographs except portraits on pages 166 and 167: Otto Karminski

training: today and tomorrow

In the autumn of 1967 Mr. C. M. Wright, well-known to many readers as the Company's Personnel Director from 1959 until November 1966, when he retired from ICI, was appointed chairman of the Chemical and Allied Products Industry Training Board. Now that the Board has been at work for just over a year, and has issued its first Levy and Grant Scheme, he talks to the Editor about the purpose of his job and gives some of his own views on the training needs of the chemical industry in the UK.

Editor: **When was your Board set up, and what industries does it cover? What are the allied products? How many firms are involved, and how many employees?**
Wright: It was set up in October 1967 and it covers the manufacture of all the very wide range of products which are clearly chemicals, plus many more. These include the manufacture of cokes; solid smokeless fuel and tar; of carbon black, and activated carbon; paints; printing ink and any drug or medicine. Also included are cosmetic or toilet compounds and perfumery; soaps and detergents; polishes and waxes and sensitive materials used in photography or to record sound and vision. It also includes the activities of the United Kingdom Atomic Energy Authority. We are concerned in all with about 1500 firms and 500,000 employees.

Editor: **What are the Board's main objectives?**
Wright: The Industrial Training Act of 1964 refers to increasing the quality and quantity of training and spreading the cost. In the wider context, we want to help the industries we serve to make the best possible use of their human resources. By this means they can become more efficient and profitable. Nor are we forgetting that job satisfaction is vital to get the best results.

Editor: **How is your Board organised?**
Wright: First of all, although we were set up by Statute, the last thing I want us to be is a bureaucratic machine external to the industry. We are part of the industry and we are here to give a service.
To do so, the Board is made up in two ways – part-time and full-time, with myself the Chairman as link man. On the part-time side, we have the members of the Board and its committees who come from all sides of our industry, from educational institutions and from the trade unions. There is a small full-time staff, about 50 people at present, which will probably never exceed 70 or 80 in all. Both the full-time staff and our part-time expert helpers work closely together in committee to draw up the policies we present to the industry, which are then put into effect through the permanent staff. The Board vets all major policy decisions before they are put to the industry.
Most of our committee members spend their working lives immersed in the problems of industry, and in recruiting permanent staff we have sought out men with a business background, who look at training in a thoroughly practical way and have no truck with training for training's sake.
And may I just emphasise that we do not just consult with industry, we bring them right into the act as policy-makers in the committees I have already mentioned.

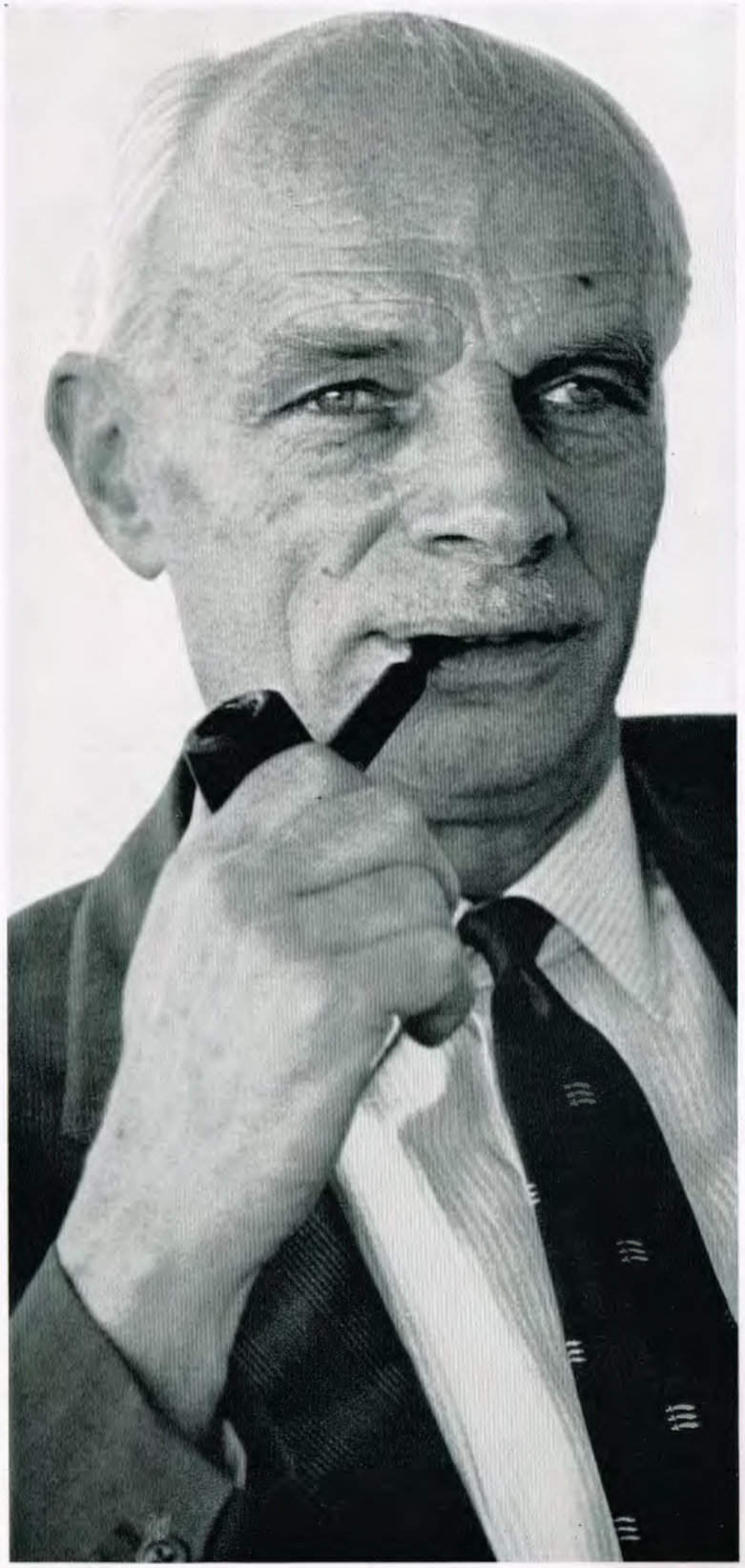
Editor: **The industry is made up of a few very large firms and a lot of quite small ones. How can the requirements of these two groups be met?**
Wright: It doesn't follow that big and small firms produce entirely conflicting problems. A large firm is often broken down into small establishments and small firms undoubtedly do some very good training. But there will be special problems with small companies, such as releasing employees for 'off-the-job' training when total numbers are very small.

Editor: **What are the industry's essential training needs?**
Wright: At this stage I accept the findings of a survey carried out by the Chemical Industries Association which highlighted four priorities: better-trained operatives, better-trained technicians, better training in sales and marketing – and also, of course, better all-round management training.

Editor: **Why does the industry need more highly-trained operatives?**
Wright: Rapid technological change has brought much greater use of instruments and removed many of the simpler jobs which used to be done by process operatives and are now done automatically or mechanically. The operative today needs a more technical understanding of the process he controls. The CIA have for some years been promoting courses for qualified and trained chemical operators in technical colleges, but much more needs to be done. A little way up the promotion ladder there is a growing demand for people called technicians – with more technical background than the ordinary craftsman or supervisor but less than the technologist or graduate. Quite a wide range of courses is springing up for this kind of man, but these need to be looked at to make sure that the training is directed to the jobs to be done in support of the graduate. At the moment this term 'technician' is loosely applied.

Editor: **What kind of slot would a properly-trained technician go into?**
Wright: They would form a layer between the craftsman and the supervisor – as at present known – and the technologist or graduate. They will be able to help in the general supervision of plants, on maintenance or development work, installation of new plants, or extensions to existing ones. There is also a growing need for technicians in research and development, and in technical service for customers – and now, with office mechanisation, for technicians on the clerical side.

Editor: **What about marketing?**
Wright: Those parts of the industry which have tended to have things very much their own way can learn a lot from the more highly-competitive sectors. As we move into an ever-more competitive world, our UK



Photograph: Michael Taylor

chemical industry must improve its marketing and think more about what the customer needs, bearing in mind that the total operation – research, manufacture, marketing – must show a profit.

Editor: **Who will train the people who are going to manage the technicians or the sales representatives? And how?**

Wright: We all accept the need for better management. However, there is too much emphasis on outside courses to improve the quality of management. The main job of improving the quality of managers lies within the firm, and it is vital to promote the right people. External courses at the business schools, at the technical colleges, or at places like Henley or Ashridge, are very much a 'topping-up' process. But they can help a manager to develop.

Editor: **Could you say more about the amount of training which will have to be done inside firms rather than in technical colleges and so on? And if firms have to do more of this, where will the trainers come from – and who will train the trainers?**

Wright: More training needs to be done, both inside firms and in technical colleges. We believe strongly in 'on-the-job' training and management training *inside* the company. On the other hand, where technical colleges already have the right staff and equipment for any particular training activity, then they should be used, since they are already paid for out of rates and taxes.

I think in-company trainers will be found largely from line management, once companies have realised what can be gained from a close look at their productivity. Training is a line-management responsibility and as many up-and-coming line managers as possible should spend a period in training as part of their career development. I also hope that in the longer run the Training Board, at present recruiting staff from the industry, will be able to feed them back again and that a two-way flow will develop. As for training the trainers, there are plenty of external courses and we are encouraging this with liberal grants-in-aid.

Editor: **Will all this help to prepare the way, in the long run, for operating plants with smaller teams of more highly-trained people at all levels?**

Wright: Yes, the main objective of training is the more efficient use of people. We must change old ideas and practices – we must for example reduce the number of layers in management, push more responsibility down the line and have more versatile craftsmen and plant operatives. Only in this way can the industry benefit fully from the better training of employees.

Editor: **Have you found that firms recognise the training need?**

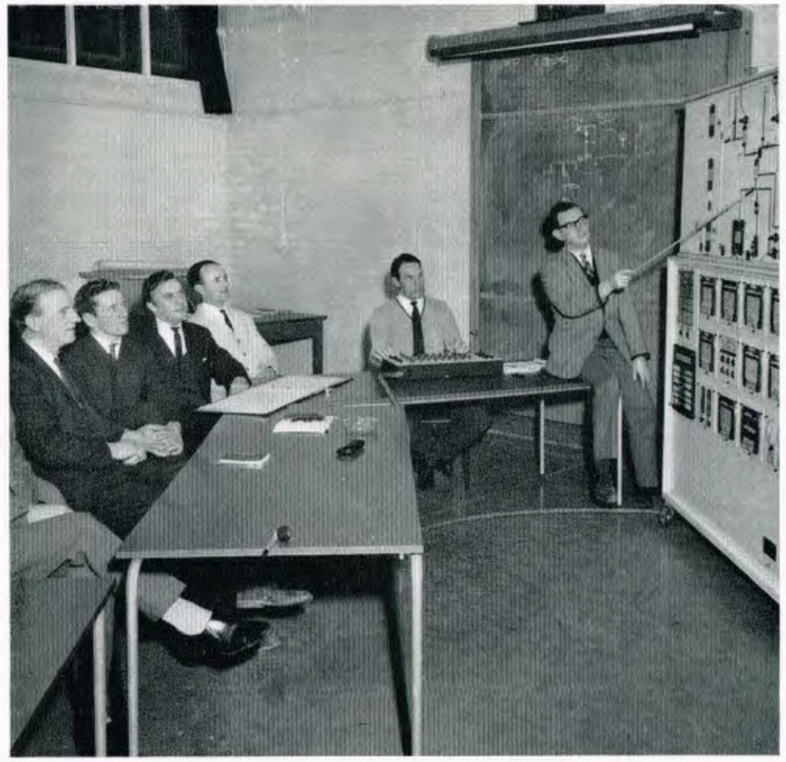
Wright: The more progressive firms have realised the need for some time. For many others it is just beginning to dawn that training can play a big part in making the best use of their people – helped by such things as the ICI and Chemical 'Little Neddy' comparisons with USA, the CIA survey I mentioned, and now the formation of the Training Board.

Editor: **Do firms think a government-backed board is the way to do the job?**

Wright: No-one likes legislation to get us to take action. However, back in the early 60s we were faced as a nation with a situation very like that preceding the 'three Rs' Education Act of 1870: things were proceeding voluntarily but not fast enough. Today, no-one questions the fundamental necessity of the 'three Rs' for everyone, although there was a lot of opposition to it in the last century. In a few years' time, industrial training will, I hope, have fitted into the landscape in much the same way as the necessity for sound basic education. The Industrial Training Act of 1964 was not something pushed through against violent opposition. There was almost unanimous all-party agreement that something must be done about training, and the Act was passed through Parliament without a division.

Editor: **How do you see your job as chairman of this Training Board?**

Wright: Now that we have set up the basic organisation and acquired a permanent office at Staines, we shall start using our committees to dig deeper into the training problems we know to exist and shall work out detailed recommendations. Recently we have set up a number of working parties to examine particular problems, e.g. operator training, computer staff training, and sales training. Our field staff will make contact with as many firms in the industry as possible over the next twelve months. This will be a difficult task – with our relatively small staff trying to get round 3500 establishments on our register. Personally, I shall spend more time visiting individual companies, and group meetings of company representatives, to get a better appreciation of training problems at first hand.



Plant operators undergo a course of refresher training at Nylon Works, Billingham

Mr. W. B. Stead

ICI and the Industrial Training Boards

All ICI employees in the United Kingdom now come within the scope of the Industrial Training Boards set up under the Industrial Training Act, 1964.

The majority, some 63,000 people in Division and Head Office establishments, come under the Training Board for Chemical and Allied Products.

Other major interests are concerned as follows:

IMI Ltd.
Engineering I.T.B.

ICI Fibres
Man-Made Fibre Producing I.T.B.

Mond Group E
Ceramics, Glass and Mineral Products I.T.B.

British Visqueen Ltd.
Rubber and Plastics Processing I.T.B.

All catering employees in Divisions and Head Office
Training Board for the Hotel and Catering Industry.

Employees in N. Ireland
Here there is parallel legislation but a separate Training Board structure.

Chemical and Allied Products Industry Training Board

Chairman: **Mr. C. M. Wright**

Employer Members:

Mr. I. E. Baggs, Director, Imperial Smelting Corporation (NSC) Ltd.

Mr. J. K. Bottomley, Production Director, Albright and Wilson (Manufacturing) Ltd.

Sir Charles Cunningham, Deputy Chairman, United Kingdom Atomic Energy Authority.

Mr. A. P. Low, Director, Lead Industries Group Ltd.

Mr. R. Morris, Production Director, Lever Brothers and Associates Ltd.

Mr. A. F. Morson, Director and Manager, Production Services, Thomas Morson and Son Ltd.

Mr. L. M. Spalton, Chairman, The Sterling-Winthrop Group Ltd.

Mr. W. B. Stead, Personnel Director, Dyestuffs Division, ICI Ltd.

Employee Members:

Mr. J. V. Bailey, Union of Shop, Distributive and Allied Workers.

Mr. D. Basnett, General and Municipal Workers' Union.

Mr. J. P. Bishop, GMWU.

Mr. E. W. Clayton, Electrical Trades Union.

Mr. J. Cousins, Transport and General Workers' Union.

Mr. J. K. Dutton, General Secretary, Association of Scientific Workers.

Mr. R. Tallon, Amalgamated Union of Engineering and Foundry Workers.

Mr. J. Williams, TGWU.

Educational Members:

Dr. S. Cotson, Head of Department of Chemistry and Chemical Technology, Borough Polytechnic, London.

Dr. W. W. Easton, Principal, Falkirk Technical College.

Prof. F. Morton, Department of Chemical Engineering, University of Manchester Institute of Science and Technology.

Mr. G. A. Winter, Chief Education Officer, North Riding County Council.

Dr. J. T. Young, Principal, Chance Technical College, Smethwick.

I went to sea on a friday

Brian McDonald

It was late November 1945, and I was 17 years old, a trawler deckhand in the port of Hull – in fact for a time I had been the youngest deckhand working out of the port. The war was just over and the first of the bigger trawlers had been released by the Naval Patrol Service, who commandeered them early in the war and left us only floating scrap-iron tubs for which they had no use. New faces were appearing round the trawler owners' offices, trawlermen just demobilised from naval service.

I had signed off my last ship to have a holiday ashore, for the war-time trawlers were in and out of port within 36 hours. On this particular morning, my holiday over, I had gone down to St. Andrews Dock to sign on, when I saw the ship. She was just back from her first fishing trip to Icelandic waters after her 'demob' and refit and had landed her catch that morning. To me she looked big, black and luxurious after the small 'scraps' I knew.

As I was admiring her, a voice behind me said: 'Will you sign on her, Mac?' and I turned to see the 'ship's husband' behind me. He was the company agent whose job it was to sign on the crew and make sure that they were all aboard when she sailed – sometimes a difficult and hazardous job. 'Just depends on who the skipper is and who is sailing in her', I answered: 'Will you show me the log?' He took me to his office, where in the ship's log book I saw the name of Dave . . ., a particular friend of mine. So I signed on at once as deckhand/trimmer.

'Will you sign on her, Mac?'

To enable these coal-burning steam trawlers to carry enough coal to last out the trip, it was the practice to fill one of the fish holds with coal, which was used first on the trip out to the fishing grounds. A long, low, narrow passage connected the fish-hold to the stoke-hold, and it was my job to load the coal into baskets and drag it through this passage to the ship's firemen. When the fish-hold was empty I would join one of the deck watches if needed. A rough and dirty job, but it paid extra money.

Then I went to see my friend Dave – and was shocked when he said that he was going to sign off the ship because 'she was a sea-cow'. He urged me to sign off also, saying she was unseaworthy and dangerous, but I said that having signed on I would stand by my decision, to keep my good name.

We sailed with the tide on a Friday (a day on which most fishermen superstitiously believe it is unlucky to sail) and although our crew was three men short we eventually got through the dock gates into the Humber, bound for Bear Island inside the Arctic Circle.

Now our bad luck started. A fireman broke his foot by dropping a large iron poker on to it, so we put him ashore at Grimsby and stood-off, waiting for a replacement, who was bundled aboard a few hours later by a lugger. Then we found that the ship's husband, caught on the hop by having to find a new fireman at such short notice, had taken on a man who had never been to sea before. He very soon became violently sea-sick, so another man had to be taken off the deck crew and put below as fireman, and then we sailed – another man short.

Heading north, it took us five days to make what was normally a 36-hour run. We battled all the way, running into a strong gale with engines at full steam, and hardly made headway. We rolled and turned, decks leaking and the bilge pumps out of action, and developed a bad list to starboard. As a result, the skipper decided to put into Kirkwall in the Orkneys for repairs, which took two days to complete.

It was afternoon as we nosed into Kirkwall and my watch below had just started, but it was far different from my previous spells. I was not thrown about in the hold and since we only wanted steam for the generators, and not the engines, I soon piled up enough coal in the stoke-hold to last the full watch.

Then I went on deck to find that the bosun, recently 'demobbed' from the Navy, had taken advantage of shelter from the weather to make up the trawl, a skilled job which only a few of his men knew. When he saw me, and despite my protests that I had finished my watch below, he ordered me to help. One of the crew, a new man who was also out of the Navy, took my part, saying: 'Leave the lad alone, he has finished his share'. The cook saved the

He glared round the table . . .

situation by calling 'tea-up' and there was a wild rush to get buckets of water from over the side to wash. I was the last into the mess-room and so I had to sit down at the end of the meal table.

The ship's cook, huge, rough-looking and rather surly, brought in the platters of food and placed them on the table. He then picked up a huge carving-knife which he started to sharpen, and while he rolled with the movement of the ship, he glared round the table. Who would complain? Certainly not me!

Later there was a fight in which the bosun stabbed the man who had taken my part on the deck. The injured man went to hospital, the bosun was arrested and taken ashore, so we were another two men short.

As we neared Bear Island, the weather – and our list to starboard – grew progressively worse. It became more and more difficult to cross the deck, made hazardous by our list, the weather, the ice and the motion of the ship, and we had to rig a lifeline along the deck.

At Bear Island we met more ice and gales and for 17 days we had to 'dodge' – keep the ship head-on into the gale – with everything battened down. To turn sideways across the wind risks shipping a beam wave – and down goes the boat. Tempers became frayed by the close confinement and the 'snarl' set in, with men bickering and quarrelling and fights breaking out.

Eventually the skipper decided that we should leave Bear Island and try our luck in the White Sea, just opened to us by the capitulation of Germany. So off we went, steaming through the Arctic towards the Barents Sea. It was perpetual night and the Northern Lights were above us most of the time, giving a beauty to the otherwise dark sea and sky. We passed the North Cape, Norway's most northerly point, in the dark, and continued along the coast beyond Murmansk and on past Russia's Cape Kanin in a half-twilight which was the nearest to daylight we would see.

Eventually we reached the White Sea and cast our trawl, and then, the weather being calmer, our work started. This meant working on deck for 20 out of 24 hours of each day. How we looked forward to our four hours in our bunks, into which we rolled after taking off our sea-boots and oil-skins – but no sooner were we asleep it seemed, than we were wakened by shouts of 'show a leg, trawlo'.

After two days, despite all the work, we had still not run across any fish and were only trawling for short spells. On the third day we struck lucky, dropping the trawl for 20 minutes and bringing it up laden each time. Soon the decks were covered with cod and haddock to be gutted and headed, and then the cod livers were reduced to crude oil in huge vats and the fish packed in ice in the hold.

By this time, our food and fuel were running low: we had only provisioned for a normal three-week trip and were then in our fourth week. The replacement fireman brought aboard at Grimsby was still in his bunk and still, as we thought, suffering from sea-sickness, but on this day he asked to be put ashore. The skipper was reluctant to do this as we had just struck the fish, so we radioed a Grimsby trawler which was fishing nearby and was going into Hammerfest. She agreed to take the fireman ashore for us. We set about lowering the life-boat from the poop deck, intending to row the sick man over, but no sooner was it launched than a gale struck us. One moment the sea was flat and calm, then came a slight howl of wind through the

rigging, and the full force of the gale hit the ship. One minute the life-boat was about 30 feet above us, the next, 30 feet below. We were lashed by ice, sleet and snow, and then we lost the boat, which broke away as the line snapped.

By some clever seamanship the skipper manœuvred back so that the life-boat was along our lee-side. Our acting third-hand (who had been promoted when the third-hand took over the bosun's duties) jumped aboard with a steel hawser to make fast across the thwart. He managed this but was unable to get back aboard ship himself. Seeing this, the skipper jumped from the bridge and, though the decks were awash, walked down towards the life-boat. As it passed him on its downward plunge, he put out one arm and grasped the third-hand by the neck of his oilskin, lifting him aboard just like a toy doll.

Because of our list, it took us about two hours to pull the boat aboard and secure it. I remember being near to tears, my hands frozen through my mitts by the intense cold whilst heaving on the boat davits, and buffeted from all sides. Eventually we managed to batten everything down again, though we had lost the fish and some loose gear washed from our decks.

Then we 'dodged' again, all during that night, tossing and rolling on our beam ends. And while we rolled, ill-luck struck again. A fireman going on watch looked in to see how the sick man was progressing – and found that he was dead. It was his first and last sea trip, and he left a wife and two children. By morning the storm had ended and we headed around the coast of Norway, through the northern fiords towards Tromsö. The following day we reached a small place called Lodogon, where we waited to pick up a pilot to guide us through the fiords. It suddenly hit me with a shock, it was Christmas morning. Food was short and for breakfast we had our own fish, fried. The menu for Christmas dinner was more sumptuous: fried fish, dry suet pudding, and dried peas!

At 4.30 in the afternoon we reached Tromsö, where we took on supplies. Food was scarce there too, and the meat supplied was reindeer and bear meat. It tasted tough and greasy – but went down well enough after so much fish.

Everywhere ashore there were signs of German occupation, and the people were friendly and helpful to the English. That night a local family invited me to their home for 'English plum cake and schnapps', but I felt guilty enjoying their hospitality as they had so little themselves.

The following day we returned to the fishing grounds, with supplies and fuel replenished, and three Norwegian fishermen aboard to help with cleaning the fish. There we fished for a further week, again working for 20 hours in each 24, but once again luck was against us – and we simply could not find the main shoals of fish.

Finally we decided that we had had enough, and so made our way back to Tromsö, where we paid off the three Norwegians; and then set a course for Hull and home. We hoped that by now we had seen the last of our bad luck, but on passing the Lofoten Islands the ship became 'hobbled', when one of the propeller blades snapped. This reduced our speed and made the ship judder so much that all drinks were constantly spilling.

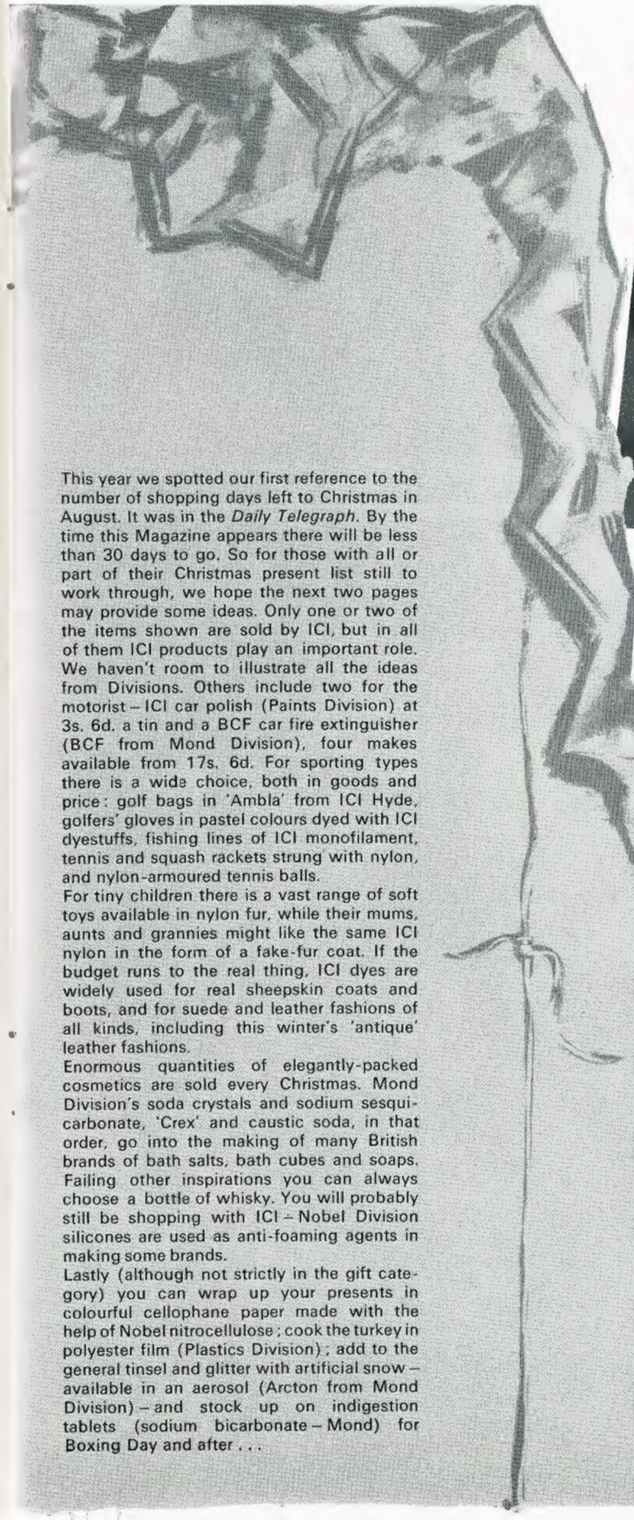
Eventually we passed Spurn Head and into the Humber. By this time, two of the crew were so impatient that they refused to wait for the tide to enter the dock and swam ashore. They'd had enough!

So after a Christmas at sea, we returned home from a trip that had taken six weeks instead of three. Our catch was so poor that it was condemned by the inspectors, and went for fish manure; we were in debt; there was no money from the catch, and a £3000 bill to meet for coal.

We all signed off after that trip! I am not superstitious, but touch wood, I wouldn't sail on a Friday again.

Lifted him aboard like a toy doll . . .

presents galore!



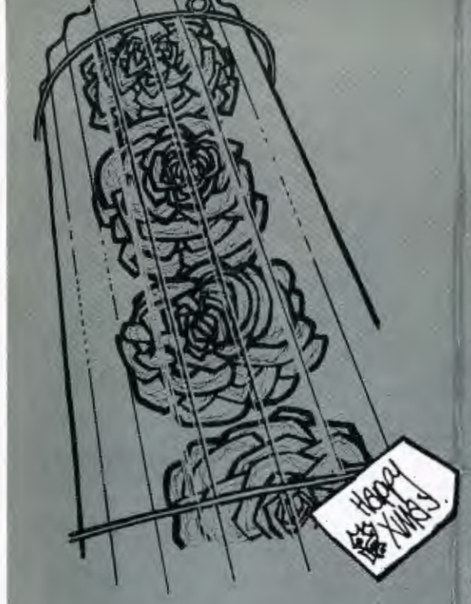
Dinky toys by Meccano Ltd. Wheels and other components made from Plastics Division's 'Kematal'. 8s. 11d., 9s. 11d. and 18s. 11d. (3 items shown)

This year we spotted our first reference to the number of shopping days left to Christmas in August. It was in the *Daily Telegraph*. By the time this Magazine appears there will be less than 30 days to go. So for those with all or part of their Christmas present list still to work through, we hope the next two pages may provide some ideas. Only one or two of the items shown are sold by ICI, but in all of them ICI products play an important role. We haven't room to illustrate all the ideas from Divisions. Others include two for the motorist – ICI car polish (Paints Division) at 3s. 6d. a tin and a BCF car fire extinguisher (BCF from Mond Division), four makes available from 17s. 6d. For sporting types there is a wide choice, both in goods and price: golf bags in 'Ambla' from ICI Hyde, golfers' gloves in pastel colours dyed with ICI dyestuffs, fishing lines of ICI monofilament, tennis and squash rackets strung with nylon, and nylon-armoured tennis balls.

For tiny children there is a vast range of soft toys available in nylon fur, while their mums, aunts and grannies might like the same ICI nylon in the form of a fake-fur coat. If the budget runs to the real thing, ICI dyes are widely used for real sheepskin coats and boots, and for suede and leather fashions of all kinds, including this winter's 'antique' leather fashions.

Enormous quantities of elegantly-packed cosmetics are sold every Christmas. Mond Division's soda crystals and sodium sesquicarbonate, 'Crex' and caustic soda, in that order, go into the making of many British brands of bath salts, bath cubes and soaps. Failing other inspirations you can always choose a bottle of whisky. You will probably still be shopping with ICI – Nobel Division silicones are used as anti-foaming agents in making some brands.

Lastly (although not strictly in the gift category) you can wrap up your presents in colourful cellophane paper made with the help of Nobel nitrocellulose; cook the turkey in polyester film (Plastics Division); add to the general tinsel and glitter with artificial snow – available in an aerosol (Arcton from Mond Division) – and stock up on indigestion tablets (sodium bicarbonate – Mond) for Boxing Day and after . . .



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A Ready-to-assemble 'Novolux' cloche pack by ICI Hyde. £1 4s. 6d. from gardening specialists and leading hardware stores.
B Tricopress shirt in Bri-nylon from the Rocola 'Golden Rapide' range. Price about £3 9s. 6d.
C Teak-handled omelette pan by Burco Ltd. with a non-stick 'Armourcote' finish using 'Fluon', ICI's brand of PTFE. Approximate retail price £1 6s. 3d.
D Ilfomatic Universal Flash camera outfit, includes cartridge-loading camera, film, flash cubes, batteries and wrist strap. Price £4 8s. 2d.
E 'Petite' typewriter by Byron Business Machines Ltd. Permanently lubricated with ICI silicone fluid (Nobel Division). Price £6 19s. 6d.
F Irish linen place mats, napkins and glass cloth by Dunmoy, dyed with ICI dyestuffs. Box of 4 mats and napkins about £1 15s. 6d., cloth 6s. 6d.

G 'Panache' jewellery fabricated by Marcel Products (Clapham) Ltd. from Plastics Division's 'Perspex'. Prices from 7s. 6d.
H Ladies' slipper by Morlands in suede, dyed with ICI dyestuffs. Available in five colours with a honeysuckle collar and a white sheepskin lining. Sizes 3–9, price £2 19s. 11d.
I Power tool made by Stanley Bridges Ltd. with casing moulded from 'Maranyl', ICI's nylon. Price £13 19s. 6d.
J Tablecloth in warp-knit Bri-nylon by W. Liddell Ltd. Available in a wide range of colours and prints. Price about £1 14s.
K Dolls by Favourite Toys Ltd. moulded from material based on 'Corvic' vinyl copolymer from Plastics Division. Prices £2 3s. 6d., £2 9s. 6d.
L House plant care, one of the new gift packs from Plant Protection Ltd. House plant pack 6s. and (not illustrated) rose care pack 17s. 3d., lawn care pack £2 4s. 9d.

M Antler Airzip case in 'Ambla' from ICI Hyde. 24 in. size £9 19s. Spartan Executive case in 'Vulkide' A, £6 12s. 6d.
N Triang pedal boat 'Sea Spray' moulded from 'Alkathene' moulding powder. Price £10 17s. 6d.
O Ladies' fluffy mules and children's bootees by Marks and Spencer in ICI nylon dyed with ICI dyestuffs. Mules, 14s. 6d. Bootees: sizes 4–6, 12s. 6d.; sizes 7–9, 13s. 6d.
P Ilford Elmo slide projector, model CS. Price £23 16s.
Q Diaries by Charles Letts & Co. Ltd. and William Collins & Sons Ltd., with covers of 'Rexine' and 'Vynide' from ICI Hyde. From 6s.
R Bra-slip by Debrette in flower-printed Bri-nylon shirting fabric. Approximate price £1 15s. Matching bra, briefs and half-slip also available.
S Orange mixture ladies' Shetland sweater by Marks and Spencer, dyed with ICI dyes. Sizes 12–14, £1 19s. 11d.; sizes 16–18, £2 2s. 6d.

G

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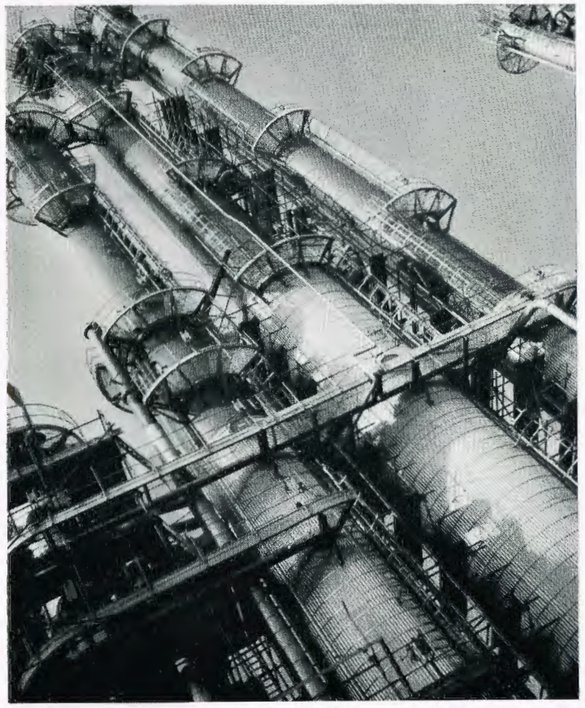
people·projects·products



Heavy Organic Chemicals Division's £3 million butadiene recovery plant at Wilton Works made news recently with an almost perfect start-up. Saleable material was produced in the exceptionally fast time of seven days from coming on stream.

Within a month of commissioning, HOC Division had received orders for almost 4000 tons of butadiene to be despatched by sea in specially-constructed, refrigerated liquefied gas tankers to the USA, France and Holland. These cargoes will earn more than £¾ million, half of it in dollars. Butadiene is used mainly in the production of synthetic rubbers.

View of HOC Division's new £3m butadiene recovery plant which made an almost perfect start-up at Wilton

New colours for ICI

Employees may soon be seeing ICI road tankers painted in a new, eye-catching livery of white, orange, black and grey, instead of the blue which has been used for many years. The change to the brighter colours is part of a much wider change in the Company's 'house style'. It will also affect stationery, signs and notices, and publicity material. Full details will be announced early in the New Year.

ICI Sponsor Steeplechase

ICI is to sponsor a 2½-mile race, the ICI 'Nitram' Steeplechase, which will be run at Teesside Park racecourse on 1st November 1969. The Company is putting up £3000 to which the course executive will add £1000, making this the country's richest steeplechase over the distance.

Agricultural Division's 'Nitram' fertilizer plant at Severnside is now operating at full capacity and the new Billingham 'Nitram' plant should come into production just before the day of the race.

Champion shot

The club championship of the smallbore rifle section at Wilton Works has been won for the second time in three years by the section's only woman member, Janette Child, who works in the Terylene Laboratories.

With a score of 388 out of 400, Miss Child beat the reigning champion, John Cuthbert, also from Terylene Works, by four points. The championship was shot outdoors and indoors and Janet included a 97 at 50 yards and a 96 at 100 yards in her total score.

Not surprisingly she has retained her place in the Yorkshire county women's team which she has held for six years. She has been working with the Company for eleven years.

Workers with brooms sweep epoxy paint, supplied by ICI de Mexico, over some 23 acres of cemented area around the principal Olympic stadium at Mexico City. Colours were violet and yellow and altogether nearly 5000 gallons of paint was used. ICI de Mexico also supplied the varnish for the floors in the Olympic village where the competitors were housed

'Famous Fairways'

A new book by Sir Peter Allen, ICI Chairman, was published at the end of September. He is well-known as a writer on railway subjects, but his latest book, *Famous Fairways*, is about another life-long interest – golf. During the course of nearly a million miles of travel Sir Peter has visited and played on about 400 golf courses all over the world, from Yellowknife in Canada to Mar del Plata, Argentina, and from Musselburgh to Melbourne. In his book, dedicated 'to golf widows the world over', he describes over 80 golf courses, 26 in North America, seven in other parts of the world and the rest in Britain and Ireland. He has played almost all the famous links and courses in the British Isles including each of those on which the Open and Amateur Championships have been held.

Sir Peter is a member of the Royal and Ancient Golf Club of St. Andrews, Rye, Royal St. George's at Sandwich and the Royal Cinque Ports at Deal. He also belongs to Pine Valley and Augusta National in the USA, and is at present Augusta's only non-American member.

ICI wins biggest-ever fertilizer contract with China

ICI has won its biggest-ever fertilizer contract with the People's Republic of China. Starting in October and continuing to March next year, Agricultural Division is supplying sulphate of ammonia and urea worth £1¼ million from its factories on Teesside. This is the first time ICI has sold urea to China. The order is one of the largest handled by ICI's new urea plant at Billingham, which was built specifically for the export market.

Last year, the Division supplied £1 million worth of fertilizer to China.

Aid for Iran

Following the terrible earthquakes which devastated eastern Iran, Pharmaceuticals Division gave 500,000 'Sulphamezathine' tablets for relief work in the stricken areas. These were made available immediately to the relief organisations from stocks held by the Division's agents in Iran, Darou Pakhsh.

A further one and a half million 'Sulphamezathine' tablets and over half a million sulphaguanidine tablets were supplied by the Division as a result of an order from the British Red Cross on behalf of the Red Lion and Sun Society, their Iranian counterparts.

'Ufoam' in 'Oh What a Lovely War'

The ICI Insulation Service, part of the Building Development Group, recently found an unusual outlet for its cavity-wall-insulating material 'Ufoam' – on the Corporation rubbish tip at Brighton in Sussex. Well versed in environment control by cutting heat losses through cavity walls, the Insulation Service experts are seen here covering 12 acres of land with 'Ufoam' to simulate snow scenes for the film *Oh What a Lovely War*. The film, an Accord production for Paramount, is being directed by Richard Attenborough and produced by Len Deighton.

What's WHAT?

A new magazine called *What?* was launched last month. Published by the new National Suggestions Centre (whose chairman is Michael Young, the creator of *Which?* and *Where?*), its aim is to provide a platform for ideas about doing things better. The Centre, an entirely independent, non-profit-making body, welcomes ideas from members of the public on any subject – from ways of running the railways more efficiently to designing a better toothbrush. Its research staff will sift them and the best suggestions will be published in *What?* In every issue there will be an award of £50 for the one judged to be the most constructive and best worked out, and £5 for each idea printed.

The Centre will be financed partly from subscriptions to *What?* from members, as *Which?* and *Where?* have been financed. It also has the backing of a number of foundation subscribers, among them ICI, Marks and Spencer, Shell-Mex and BP, and Unilever, each of whom are contributing £1000 p.a. for two years. Surveys carried out by the Centre to find out the areas in which the public are most ready to suggest improvements show industry coming second only to transport, rating one suggestion in six from those interviewed. ICI will receive special reports on all suggestions which have a bearing on its own operations.

Contents of the first issue include the case for parking discs instead of meters, a report on rubbish collection services, and an experiment in keeping in touch with elderly people by telephone.

A year's subscription to *What?* is £1 for four issues and should be sent to WHAT? National Suggestion Centre, 18, Victoria Park Sq., London E.C.2.

Quicker laundering for QE2 – with synthetic fibres

Washing, drying and ironing 4000 sheets a day is a considerable undertaking by any standards, especially when it has to be done at sea. But it will be no problem aboard the new Cunarder *Queen Elizabeth 2* when she sails on her maiden voyage early in the New Year.

Not only is her laundry equipment the most modern in the world, but items such as sheets, blankets and towels – which will form the bulk of the 12,000 to 14,000 articles handled each day – have been chosen with one eye on their 'launderability'.

Extensive use is made of synthetic fibres such as ICI's Bri-Nylon, Terylene and Crimplene. Tests on Terylene/cotton sheets in a 67/33 blend showed that they could be put through the calender at 75 feet per minute instead of only 40 feet per minute. Similarly, tests with Bri-Nylon blankets showed that the cycle for washing, rinsing and tumble-drying could be reduced to only 15 minutes instead of 40 minutes or more.

Altogether the *Queen Elizabeth 2* will carry 16,000 sheets and a similar number of pillow cases, all in 67 per cent Terylene/33 per cent cotton, by Eckersleys Ltd.; 6500 Bri-Nylon blankets by Moonweave Ltd; 10,000 white bath towels and 5000 blue swimming pool towels with a Terylene/cotton ground fabric, by Wm. Christy and Son; 1000 shower mats and 1800 bath mats, all in Crimplene, by Swanwic Textiles. Although all these items have been produced to Cunard specification, they are basically similar to articles available in the shops.

Sir Peter on the Ffestiniog

The Chairman of ICI, Sir Peter Allen, accompanied by Lady Allen, visited Cooke's Explosives Ltd., at Penrhyndeudraeth in North Wales, a wholly-owned subsidiary of Nobel Division, on the afternoon of 12th September. The factory, set high above the Dwyryd estuary overlooking Portmadoc Bay, employs over 400 people and produces explosives for mines and quarries.

Earlier in the day Sir Peter travelled into the surrounding hills – on the footplate of the Ffestiniog Narrow Gauge Railway's famous locomotive *Iarll Meirionnydd* (The Earl of Merioneth). Sir Peter drove the locomotive part of the way along the winding 10-mile track from Portmadoc, at sea level, to Ddault, six hundred feet up on the Dwyryd river watershed.

Obituary
Dr. Maurice Cook

Dr. Maurice Cook, a director of the former Metals Division for twenty years and Chairman of the Division from 1957 until he retired in 1959, died on 7th August at the age of 70. Dr. N. P. Inglis, Division Research Director from 1951 to 1964, writes:

Maurice Cook was born in Hartlepool and, despite 42 years' residence in the Midlands, the first thing he looked for in his Saturday evening paper was to see how Hartlepools United had fared in the Football League!

After graduating from Manchester University with a first-class honours degree, he went to Cambridge, where he carried out metallurgical research under the famous Colonel Heycock. With a Ph.D. from Cambridge, Cook started his long industrial career with C. A. Parsons Ltd. in Newcastle, where he worked closely with Sir Charles Parsons.

In 1926 he came to Witton to begin that long association which proved so happy and profitable to both employer and employed. He won the respect of Dr. Brownsdon, which was no mean feat, and succeeded Brownsdon in 1939 as Director of Research and a member of the Metals Division Board. He went on to build up a Research department which became recognized as one of the foremost metallurgical laboratories in Europe, and the stream of well-written and well-based scientific papers which emerged bear tribute to this. He excelled in scientific leadership and was happy and skilled in his scientific partnerships.

The series of Cook-Richards papers, broadly covering texture of metals, and the various Cook-Larke papers on the rolling of metals, are rightly regarded as classics, while his last major scientific contribution, with E. W. Swainson, on melting of reactive and refractory metals, in 1959 will bear reading by all workers in this field.

In 1950 he left the Research department, and after a short spell as Director in charge of Wrought Metal Production he became Managing Director (Technical) in 1952 and finally Division Chairman in 1957.

He had the fairly rare attribute of being both a first-class scientist *and* a good administrator. He was a highly-efficient chairman of a meeting, making sure that the taciturn and shy had their say while fairly discouraging the over-loquacious. It is not surprising, therefore, that various bodies and organisations demanded his help, which was always willingly given.

He was President of the Birmingham Metallurgical Society, the Institution of Metallurgists, the Institute of Metals, and the Aluminium Development Association at various times, and chairman for many years of the British Non-ferrous Metals Research Association. His participation in all these duties was very real.

Despite his scientific eminence and the very many honours which he received, Maurice Cook was a very friendly man and a good mixer. He had a wonderfully sharp wit and was a master raconteur, no story ever losing anything in the telling.

Far too much of this memoir has been devoted to his considerable achievements, but whilst his many friends will honour and respect him for these they will remember him as a good friend and humane man. He was a man of honour, integrity and kindness.

ICI man heads new centre

On 1st November Mr. John Busby, formerly a senior construction engineer with Dyestuffs Division's Nylon Works at Stevenston from early 1966, became the University of Strathclyde's first Director of Industrial Co-operation and head of the University's new Centre for Industrial Innovation. Largest of six supported by the Ministry of Technology, the Centre will provide a broadly-based consultancy service of technological research for small and medium-sized firms which must diversify and develop to stay alive – but which cannot support permanent research and development teams.

Now 38, John Busby's career began at 16, when he joined the East Midlands Electricity Board to train as a junior distribution engineer. From 1946 until 1950 he also studied at Northampton College of Technology where he gained the ONC and the HNC in electrical engineering, followed by four years at Nottingham University from which he graduated with honours in electrical engineering in 1954.

After National Service as an officer in the Royal Engineers he joined Dyestuffs Division at Blackley in the electrical design team. In 1957 he was transferred to Nylon Works, Wilton, to be works electrical engineer, then plant maintenance engineer until the end of 1961 when he became much involved in nylon capacity expansion.

His hobbies include hill-walking and sailing on the Firth of Clyde. Also an enthusiastic Scottish country dancer, he wryly points out 'there's more Scottish country dancing in England than in Scotland itself.'

Hundredth birthday

Telegrams and flowers from relatives and friends all over the world arrived at 12 Inwood Road, Garston, Liverpool, on Wednesday, 25th September for Mrs. Margaret Gately, who was celebrating her 100th birthday.

Mrs. Gately is an ICI pensioner's widow, and in a special place of honour alongside a telegram from the Queen was a personal letter from ICI Chairman, Sir Peter Allen. Our picture shows one of Mrs. Gately's early callers – Mr. Sam Ray, Mond Division pensioners' visitor, with a bouquet of flowers from the Company.

Mrs. Gately's husband, Thomas Gately, died in 1964. He joined the Company in 1892 and retired as a yard foreman at Gaskell Marsh Works in 1933. Mr. and Mrs. Gately were married in 1906.

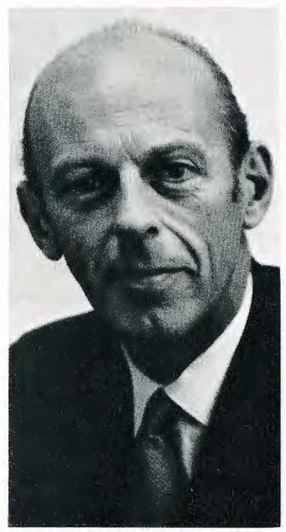
GOING MONTHLY – AT HALF THE PRICE

From January onwards ICI Magazine will appear once a month. But it will not only be coming out more often, it will have a completely new look; with bigger pages, more pictures, better coverage of Company and Group people and events at home and abroad, at work and at play.

In particular, the Editor would like more employees throughout the Company to write about their personal experiences, their interests and their hobbies, and to suggest ideas for articles. A special panel with representatives of both staff and payroll and all age groups is being created to keep the Editor informed on the various topics ICI people want to read about in the Magazine.

Our first new issue of ICI Magazine (which will in future cost only 2d. – half the present price) will include a description of the Company house style, a new look for everything from road signs to writing paper; an account of a fiery Hogmanay in the Highlands; the role of Terylene in the quest for the perfect potato in Australia; and an illustrated account of the night shift at ICI's Wilton Works.

There is also a competition with £100 offered in prizes. Find out all about it in the January Magazine. There will be others from time to time.



Cedric Jagger is assistant to Donald Haffenden, ICI's General Manager – External Relations. He joined the Company in 1938 as a member of the Supply Department of Mouldrite Ltd., forerunners of Plastics Division. Returning to ICI after six years' war service, he transferred to African Department in Head Office in 1947, and to the old Central Publicity Department in 1953. His principal outside interest is a study of the history and instruments of time measurement, about which he has been researching and writing for twenty years. He is also a keen photographer, enjoys music, and was, until recently, Chairman of the Governors of a school near his home.

Brian McDonald is a laboratory assistant at Nylon Works, Billingham. He left school at 14 in 1942 and worked for a few months as an apprentice shipwright before going to sea. Starting as a galley boy on trawlers, he progressed to deckhand seaman while still only 15. After four years at sea, he joined the Dragoon Guards, rising to the rank of sergeant and serving in Europe and the Middle East. Demobbed in 1952, he was in the police force for nine years before he joined ICI at Billingham in February 1961.

Navin Sullivan has been concerned with the communication of science most of his working life. After graduating in medicine and psychology at Cambridge University in 1950 he went into technical journalism and from there into scientific book publishing, where he has remained, working with various companies here and in the United States. Besides his publishing work, he has found time to write several books about science and scientists, of which the latest, *The Message of the Genes*, has just been published in New York and London.

how scientists think- and feel

Navin Sullivan

More than ever before, the scientist needs to communicate to the layman. Modern science requires the spending of vast sums of public money on such things as nuclear particle accelerators, radio telescopes and space rockets. Scientists need to explain why this money is necessary. In industry, they must convey the meaning of their research to others, and suggest how their results can be exploited commercially.

Equally, the ordinary man needs to understand how science affects his everyday life, for good or ill. Should drinking water be fluoridated? What can be done about water and air pollution? How widely should antibiotics be employed in medicine and agriculture? Can pesticides be harmful if used heedlessly? Such matters concern us all.

Understanding needed

Unfortunately, there is still a gulf between the layman and the scientist, who is still regarded by too many people as a remote, almost superhuman figure, whose work they can never hope to understand. This attitude is a real barrier to communication. Nor is it enough to tell them of scientific achievements, because the way in which these have been arrived at remains mysterious. What is needed is some understanding of how scientists carry out research and what they feel about it.

How is the ordinary layman to understand how the scientist works? Certainly, he has not been helped by the scientist's traditional preference for presenting his final, polished results but omitting any mention of his struggles before reaching them. The physicist Hermann von Helmholtz once compared himself to a mountaineer who takes a very difficult route to the summit only to discover, once there, that there is a 'royal road' by which he might have ascended. He added that in his writing he naturally said nothing about his mistakes, and told the reader only of the easy way. This method makes for clear understanding of the facts, but it leaves the rest of us completely in the dark about how research is actually carried out.

Hopes and fears

Nor does it help the ordinary reader to understand how scientists feel when accounts of research suppress all mention of personal feeling. The impression given by these accounts is that science is a remote, icily calm activity. Nothing could in fact be farther from the truth. Not only is scientific research highly creative, and consequently full of hopes, disappointments, and sudden, joyful successes; but scientists themselves are as liable to personal struggles, feuds, and jealousies as anyone else. In particular, they are intensely eager to publish successful results ahead of a rival – with the result that they may publish too soon and later have to correct their work.

The only research scientist to ignore tradition and bravely describe the real hopes and fears surrounding his work has been James D. Watson. In *The Double Helix* he gives what admittedly is a highly personal and biased account of the way in which he and Francis Crick elucidated the structure of DNA. Not surprisingly, publication of his book earlier this year (1968) really set the cat among the molecular biology pigeons, and at one time there was wild and wistful talk of libel actions against the author. Although Watson is doubtless unfair to the other protagonists – and, indeed, to himself – his book succeeds in conveying a true impression of a research scientist living his science from day to day.

The scientist must choose whether to dispel the aura of mystery with which he has surrounded himself, and reveal that he is engaged on a very exciting, but very human, adventure. If he does so, he then faces the twin problems of explaining the facts of science, and conveying the scientific outlook. Of the two, the second is the more important, and the more neglected. While facts may need changing because of fresh discoveries, the outlook remains fundamental.

What do they know?

In trying to explain the facts, a scientist shares the difficulties confronting any specialist trying to tell non-specialists about his work. What should he assume his audience already knows? How can he explain complex details to people who are unfamiliar with their general context? But the scientist also faces special problems. Accustomed as he is to thinking in extremely close detail, he forgets that most people manage to get along at a more general level. Able to deal in the abstractions expressed by mathematics, he must communicate to people who prefer to visualize what he is talking about.

Despite these discouragements, many scientists have succeeded in popularizing their work, sometimes with remarkable vividness. Here, for instance, is Sir Charles Sherrington describing nervous activity in the brain: 'The brain is waking and with it the mind is returning. It is as if the Milky Way entered upon some cosmic dance. Swiftly the head-mass becomes an enchanted loom where millions of flashing shuttles weave a dissolving pattern. . . .'

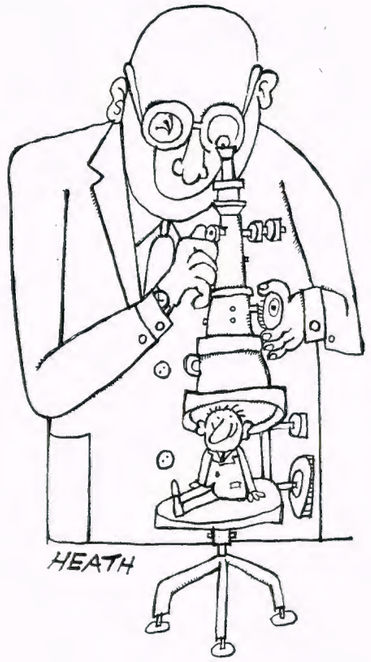
Even without striving for such effects, the scientist who tries to explain his work as simply as possible usually finds the effort intellectually rewarding. A first essential is to write simple, direct English rather than the complicated, impersonal language of the research paper, always avoiding jargon wherever he can. A second essential is for him to remember his audience, and continually ask himself whether some idea or phrase of his presupposes knowledge that they will not have.

It's new – to others

Putting oneself in another's place is always a difficult imaginative feat, and the scientist may find it almost impossible to realize how much remains new to others when he has long since taken it for granted. Here he can be helped by someone who is interested but relatively uninstructed and who, acting as a filter, insists upon further and further clarification until the scientist at last finds – often to his own surprise – that he has produced a shiningly simple account.

However well such simplifications communicate facts to non-specialists, they rarely convey an appreciation of the scientific outlook as well. Yet this is ultimately necessary if the work of the scientist is to be fully understood.

According to T. H. Huxley, the Victorian scientist and popularizer, we all use the scientific method from time to time. He instanced someone in a greengrocer's shop who



tastes a hard, green apple and finds it sour; tastes another and finds that sour too; and then refuses a third because he assumes that it will also be sour. Huxley pointed out that the customer has used experience and logical thought to arrive at a generalization – that all hard, green apples are sour – and this is essentially the method of science. (Huxley could have added that if the customer later encounters another variety of apple that is hard and green but not sour, he will, of course, have to alter his generalization – again, like any good scientist.) The ability to give up a personal theory, however dearly held, perhaps for many years, when it proves inadequate, is the mark of the true man of science.

Perhaps Huxley was right, and we all use scientific method occasionally. However, the main difference between the scientist and the rest of us is that we do not use it consistently and professionally. And Huxley's example is very simple in comparison with the kind of problem usually encountered by a research scientist.

The fact is that the scientific method is foreign to most of us, and little effort is made to communicate it to, at any rate, the adult population. We are given news of scientific discoveries, but we remain unaware of what science is all about. Fortunately, however, important attempts are now being made to correct this situation so far as the younger generation now being taught science at school is concerned. These attempts are designed to communicate the scientific outlook to everyone capable of grasping it.

The way this is being done is by a revolution in the teaching of science in schools, and it stems from exciting new collaboration between research scientists and school teachers. The first was in the United States and was designed to make radical alterations in the teaching of high-school physics. Other joint ventures followed, including the Nuffield Science Teaching Project in Britain. All these initiatives have in common the object of communicating real, living science instead of an arid system of facts.

Thrill of discovery

How is this to be done? In most instances, the scientists involved have insisted that the children should follow scientific method and enjoy the thrill of discovery for themselves. Within skilfully-erected frameworks of enquiry, the children undertake what are, for them, real experiments. They then form explanations of their results. These explanations are not, of course, comparable to those reached by real scientists, but this does not matter: what is vital is that the children should think and work scientifically and evolve explanations that are adequate for their own purposes.

This classroom revolution is intended not only to produce better scientists, but to leave ordinary people with a desire to question, to investigate, and not to rely blindly upon authority. If it succeeds, its ultimate effects may be immense. People in many more walks of life, doing all kinds of different jobs, in a wider range of activities will be better equipped to apply scientific methods in their own areas; they will also be better able to share the thinking and the responsibilities of the scientist. When that time comes, the problems of communicating science will be very much easier than they are today.

Greenwich preserved

Cedric Jagger

London's fog and smoke are no respecters of star-gazers. So, twenty years ago, the Royal Observatory was moved from its original home at Greenwich to Herstmonceux Castle, Sussex. Re-christened – despite its new location – the Royal Greenwich Observatory, it became fully operational only in the mid-fifties. What was so special about the first 'Greenwich' that its name should be thus preserved – and what has become of it now?

It is not much more than a century-and-a-half since the greatest of marine perils was finally defeated – the inability of ships' captains to locate their position with any accuracy when out of sight of land. Before that time losses from shipwreck, scurvy and starvation were just as great as than from storms or tempests. The problem had long been recognised. Charles II, an enlightened monarch with an enquiring mind in scientific matters and a sound appreciation of the nation's commercial needs, deplored the appalling waste of men and materials caused by the lack of any reliable means of finding out a ship's longitude at sea. Latitude – the distance north or south of the imaginary meridian we call the Equator – is comparatively easy to determine. But before a position on our turning world can be pin-pointed, you need another co-ordinate, measuring your distance east or west of another imaginary meridian passing through the two poles. This – the longitude – was the problem; even given an internationally-recognised meridian (Longitude 0°), from which to measure points east or west, reliable calculations involve the use of a timekeeper capable of performing with true precision at sea. In the 17th century both were lacking.

So in 1675, Charles II established by Royal Warrant an Observatory in his Royal Park at Greenwich 'in order to the finding out of the longitude of places, and for perfecting navigation and astronomy.' Three men played leading parts in this venture. The structure was designed by Sir Christopher Wren, and it was built by Sir Jonas Moore, the Surveyor-General of Ordnance. And the first 'observator', or, as we should now call him, Astronomer Royal, was John Flamsteed.

Flamsteed, a young Derbyshire clergyman, was already making a name for himself as an astronomer and mathematician. When he began 'to measure distances in ye Heavens', at the end of 1676, he cannot have found the job any sinecure since, although the Royal Warrant took account of his modest salary as well as that of an assistant, it did not provide for any equipment at all. For the rest of his working life – he died in 1719 – Flamsteed had to beg, borrow or pay out of his own pocket for everything he needed. At one time, he even had to give students board, lodging and tuition for a guinea a week to make ends meet.

Yet none of these privations deterred Flamsteed. Over the years he somehow acquired everything he needed to enable him to amass a formidable body of some 40,000 observations. These formed the basis of his star catalogue – a monumental three-volume work published after his death, which effectively established him as the founder of modern positional astronomy.

To date, ten Astronomers Royal have followed in Flamsteed's footsteps, and each has added more lustre to the Observatory's reputation. Flamsteed's immediate successor was Edmond Halley, who took office only to find that Flamsteed's executors had stripped the Observatory bare of all its instruments and sold them up as part of the deceased's estate. Halley managed to obtain a small grant from the Board of Ordnance to start up again, and went on not only to compute the orbit of the comet which bears his name but to play a leading part in the publication of Newton's *Principia,* which laid the foundations of theoretical mechanics. James Bradley, following Halley in 1742, spent a long time overhauling Halley's instruments and installing even more; his transit observations, incorporating the most highly-technical corrections for error, are the earliest observations

still of continuing use to astronomers today. Nevil Maskelyne, who held office from 1765 to 1810, published the first *Nautical Almanac* in 1767. This has been published annually ever since and continues to be one of the standard aids to navigation. He was also associated with the inventive genius of John Harrison, who perfected the first really accurate marine timekeeper, winning a substantial prize from Parliament in the process. It was still to be many decades, however, before further refinements made it possible to manufacture enough of these to supply every ship with one for use at sea.

John Pond succeeded Maskelyne as Astronomer Royal in 1811. Another exceedingly skilful observer, his catalogue of 1112 stars, completed in 1833, added substantially to the knowledge of his day. In 1818, the Royal Observatory first undertook the testing of marine timekeepers – properly called chronometers – for the Royal Navy, a task it continues to perform. In 1833 the first 'time signal', a visual one consisting of a ball, which dropped the length of a 15-ft mast sited on the Observatory roof at 1 p.m. every day, was put into operation for the benefit of shipping on the Thames and the chronometer-makers across the river in Clerkenwell.

In the latter half of the last century, the most celebrated Astronomer Royal was probably George Airy. In 1851 – the year of the Great Exhibition – he installed his gigantic meridian instrument, the Airy Transit Circle, which continued to define the Greenwich Meridian, i.e. Longitude 0°, with the most extreme accuracy right up to 1954. It is still maintained in perfect working order. The Greenwich Meridian was not accorded international recognition until 1884, during William Christie's term of office as Astronomer Royal. His successor, Frank Dyson, introduced the famous six pips radio time signal in 1924, while in 1936 the Royal Observatory, then headed by Harold Spencer Jones, initiated automatic control for the GPO's Speaking Clock, TIM. It was at about the same time that the first quartz clocks, of unbelievable accuracy, were introduced. The present Astronomer Royal (at Herstmonceux) is Sir Richard van der Riet Woolley.

What of Greenwich today? When the working observatory moved away, it was decided to convert the fine old buildings into a museum illustrating both the history of the Royal Observatory itself and also that of astronomy and navigation in general; and, as far as possible, to restore and equip them to show the many historic instruments used at Greenwich during its long and active life.

All this work has taken a long time, but is now virtually completed; what remains to be done will, it is hoped, be ready for the tercentenary celebrations in 1975. The largest Observatory building which is open to the public, the South Block, was finished in July 1967. Part eighteenth and part nineteenth century in construction, it straddles the Greenwich Meridian, and contains, among many other fascinating exhibits, Airy's great Transit Circle. But for me, the principal attraction at Greenwich will always be Wren's miniature masterpiece, Flamsteed House. This is, of course, the oldest observatory building and still in a fine state. Flamsteed had his living quarters on the ground floor, and these have been restored to their original condition by means of loans of furniture and fittings from the Victoria and Albert Museum. Below stairs were cellars and kitchens, while upstairs, is the magnificent Octagon Room. Eight-sided, and 34 ft across by 18 ft high, this room was Flamsteed's office and one of his observation points. It now contains reproductions of many of the instruments associated with Flamsteed, including the two Great Clocks, inset into the wall panelling. Given by Sir Jonas Moore and made by the famous clockmaker Thomas Tompion, these were high-precision clocks of their time, with pendulums thirteen feet long mounted above the movements, which beat out intervals of two seconds.

The attraction of Flamsteed House is not only one of scale – one tends to associate Wren with public buildings and churches, and not with what is, by any standards, only a medium-sized house – but also his unique ability to infuse even the unpromising circumstances of astronomy with surroundings of great dignity and beauty in themselves. In his own words, he built it 'for the observator's habitation, and a little for pompe.'

Overleaf: Flamsteed House, Greenwich, Wren's miniature masterpiece. The Octagon Room on the first floor is now surmounted by the Time Ball on its mast. The first 'time signal', it was put into operation in the 1830s for the benefit of shipping on the Thames.

Opposite: The Meridian Room, in the South Block. The roof shutters and eaves-to-doorstep doors have been opened. The longitudinal line of this large telescope defines the Greenwich or Prime Meridian of the world (Longitude 0°).

Inset, left: Flamsteed's Sextant House – one of his main observation points – showing his 7 ft Equatorial Sextant in replica. The original was made in 1676 at the Tower of London, to Flamsteed's design.

Inset, centre: Interior of the Octagon Room, showing a replica of a telescope such as Flamsteed must have used. A contemporary print shows an instrument of this design.

Inset, right: The same print also shows a Quadrant such as this one, in use. In the background, Thomas Tompion's two Great Clocks set into the wall panelling.

Right: The Bliss Gallery houses the second largest collection of planispheric astrolabes in the world – the largest is in the Museum of the History of Science at Oxford. The oldest form of analogue computers, they enabled sunrise and sunset and the positions of stars to be predicted. In the foreground, a selection of globes.

Photographs: Gerald Howson

a filter for the Findhorn

Philip Reilly

A filtering medium, 'Flocor', made by ICI, not only helps Highland whisky distillers to increase their output, it protects some of Scotland's famous fishing rivers from pollution.

The Findhorn, the Deveron and the Spey, which all flow through the wild but beautiful country lying between the northerly edges of the Grampian mountains and the sea, are among Scotland's best-known fishing rivers.

They are also famous for another reason. On their banks, or beside the clear waters which feed them from the surrounding moors and hills, stand many of the whisky distilleries which have made this small corner of north-east Scotland a source of one of Britain's greatest exports and earned a unique reputation.

From these distilleries – on Speyside there seems to be one around every other bend in the winding road from Grantown-on-Spey to Graigallachie, although elsewhere they are not quite so plentiful – come many of the millions of gallons of pot-still malt whiskies produced in the Highlands every year. Most of the output goes for 'marrying' with other malts and with grain whisky, made from unmalted barley or other grains, to produce the famous blends of Scotch – the Highland Creams, the Standfasts, the Vat 69s and all the others – which are sold throughout the world. The rest, a comparatively small amount, is bottled and sold as unblended or 'single' malt whiskies. With brand names which read like a battle-roll of the clans, these are savoured by the small but growing numbers of malt-drinkers who will tell you that *their* favourite is like no other whisky in the world. The surprising thing is that every one of them will be right.

For the product of each separate distillery, large or small, *is* different from that of any other, even a neighbour half-a-mile away in the same glen. In some cases the differences are marked, in others they are so subtle that it takes a skilled blender to detect them. But they will be there. And it is for these variations that the products of particular distilleries are sought, by the blenders of well-known 'commercial' brands and by the connoisseurs who drink nothing but single malts.

Why each malt whisky should have its own distinctive qualities is hard to say, for while methods and equipment may be more modern in some than in others, at every Highland distillery the process for making malt whisky remains basically the same.

It starts with the malting of Scottish or English barley, by steeping it in water and then leaving it for eight to 12 days to germinate in conditions of warmth and moisture, often on concrete 'malting floors', where even today it is hand-turned regularly by men using wooden-bladed shovels. This process modifies the starch in the barley and develops enzymes which are capable, in a subsequent operation, of converting the starch to sugar. The growth is then stopped by taking the malted barley, known as 'green malt', to a kiln for drying. It is dried over a peat and coke fire, or one burning peat alone, and it is the smoke from the burning peat which gives a characteristic flavour or 'reek' to the sprouted grains.

At the next stage the ground malt or 'grist' is mixed with hot water in giant 'mash-tuns', where the malt starch is liquified into a sweet liquid known as the 'wort'. This is drawn off – leaving the grain husks for use as cattle-food – cooled, and then pumped into 'wash-backs', vessels holding anything from 2000 to 10,000 gallons, to be fermented by yeast.

The living, growing yeast attacks the sugar in the wort and converts it into CO_2 and crude alcohol. After 36 to 48 hours it produces a liquid, the 'wash', which contains low-strength crude alcohol, some unfermentable matter, and by-products of fermentation and bacterial action.

Next comes distillation, a batch process carried out in copper 'pot-stills'. These oddly-shaped vessels, rather like inverted bells, may hold 5000 gallons or more. Malt whisky is distilled twice, first in a 'wash-still', where the crude alcohol is separated from the fermented liquid and other residues, and then in a 'spirit still'. There the drinkable, or 'potable', part of the distillate – the second runnings – is separated from the first and third runnings, which are returned to the process. In the pot-stills, the wash is heated to a point where the alcohol becomes vapour. The vapour rises, to be drawn off and cooled in a condenser until it becomes a liquid spirit which is run off into a 'low wines and feints receiver' and then to the spirit still for the second distillation.

Malting, kiln-drying over peat smoke, fermentation, and the skill of the still-man in deciding when to begin and end the collection of potable spirit from the still – all help to give each individual batch of whisky its own flavour. But more than anything, the difference between the products of one distillery and another seems to depend on the water used. Soft, clear acid water from red-granite streams is the ideal, but each source of water varies from all the others, and each produces different whiskies. Which is why all distilleries guard their individual water supplies so very carefully. From their own streams, they take up large amounts of water for process, for cooling, for washing plant and equipment. And into those streams, they want to be able to discharge effluents which are the inevitable result of distilling whisky – but they cannot do so without first treating the effluents until these reach a required level of purity. For these tiny burns and streams flow eventually into fishing rivers, the Findhorn, Spey and Deveron among them, and the local river authority watches closely for signs of pollution.

Untreated, distillery effluents could lower the level of oxygen in the rivers until salmon and other fish could no longer survive. The waters would become foul and unsightly and the hotels and tourist industry would suffer.

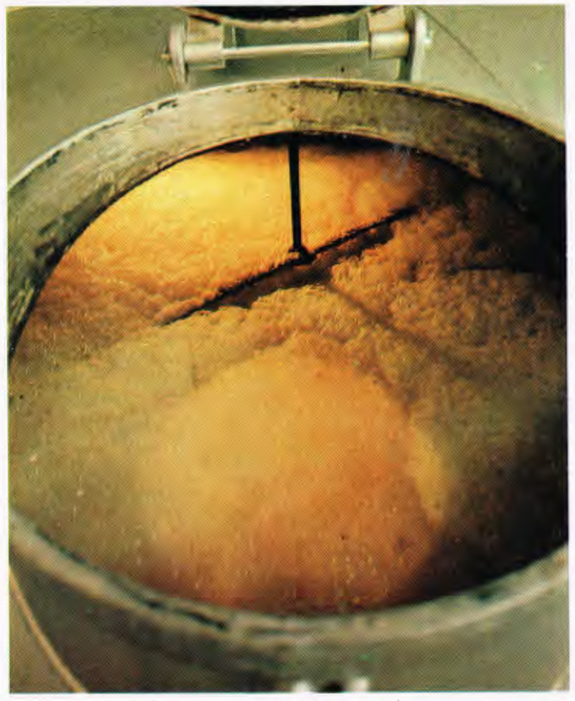
In recent years the river board has insisted on higher levels of purity than ever, and these demands have coincided with a vast expansion in whisky production, to create a two-sided problem for distillers. How could they increase output – and therefore the amount of effluent – while making sure that the final discharge into the rivers was cleaner than at any time in the past?

Some built or extended the sort of percolating filter beds used over many years. Others, including some of the biggest distilleries, have turned instead to 'Flocor', the ICI system being used increasingly both in Britain and overseas to treat effluents which can be 'broken down' and purified by the action of natural biological organisms.

Developed by ICI (Hyde), who make it, and the Company's marine research station at Brixham, Devon, 'Flocor' is made from sheets of flat and corrugated pvc (polyvinyl chloride) plastics built up to form patented honeycomb-design sections which are fitted as a packing material into filter towers. It provides the conditions in which the natural organisms, the 'bios', can most efficiently degrade or break down the effluents passing over the plastic surfaces of the sections.

Copper pot-stills like these at the Ardmore Distillery of Wm. Teacher and Sons Ltd., near Huntly, Aberdeenshire, are the heart of the age-old process for making Highland malt whiskies

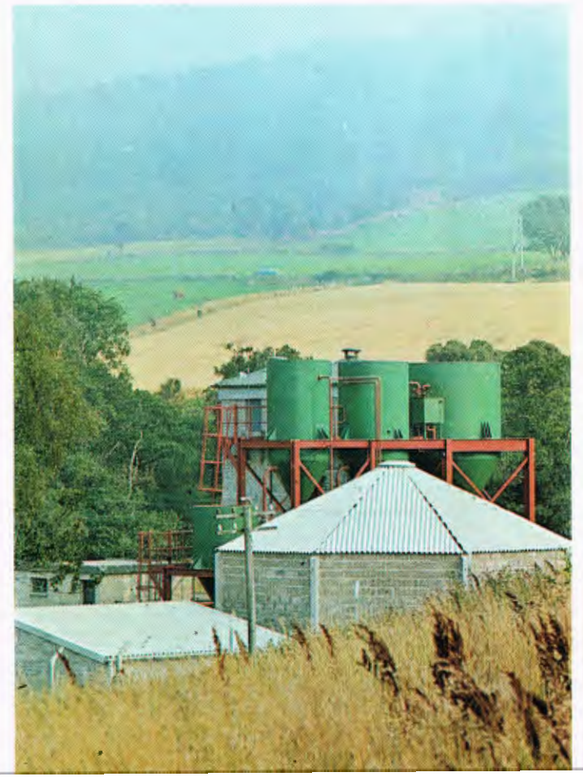
Yeast fermentation taking place in a 'wash-back' at Tomatin Distillery. Froth forms on top of the liquor during fermentation and today many distilleries use ICI silicones from Nobel Division to control it

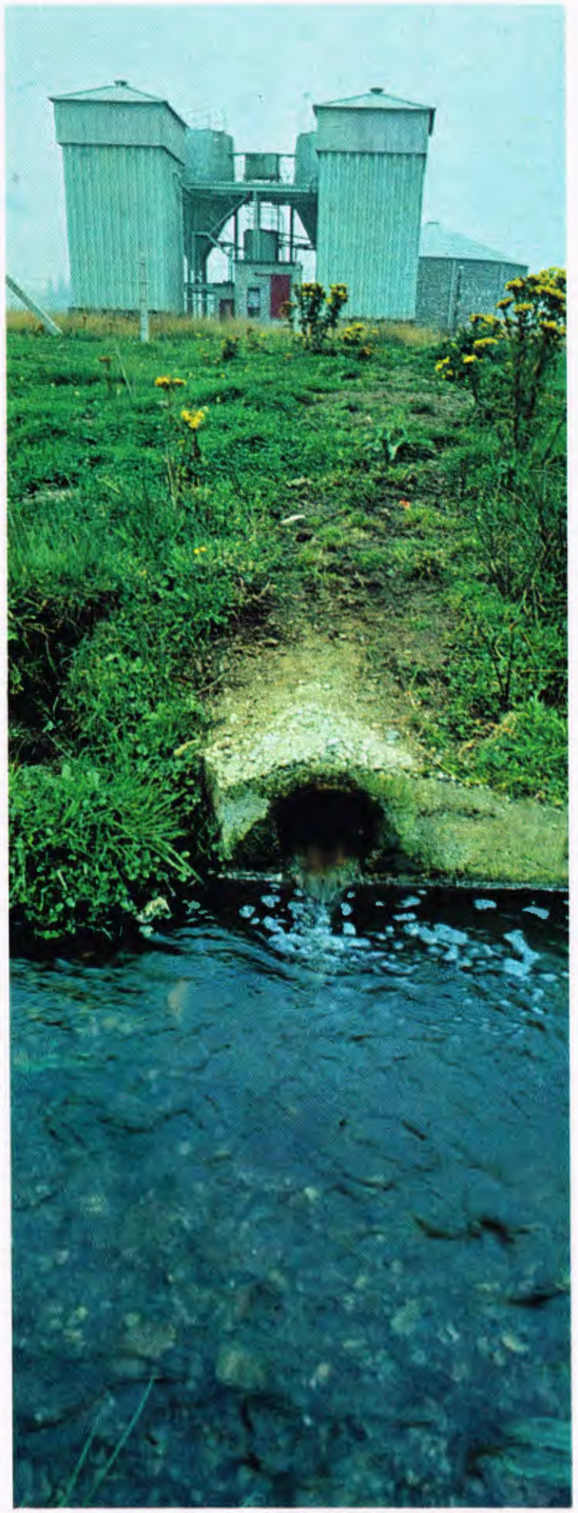


Photographs: Michael Taylor

Each of these 'wash-backs' at Ardmore holds about 7000 gallons of 'wort' which is fermented for 48 hours to convert the sugars from malted barley into crude alcohol. After fermentation the liquor contains 11 to 12 per cent proof spirit

One of the newest 'Flocor' installations in Scotland is at the Glenallachie Distillery near Aberlour, opened only this year. Effluent treated in this plant flows into a nearby burn and then into the river Spey





After treatment in the twin towers of the 'Flocor' installation in the background, effluent from Ardmore distillery flows into this tiny burn, no more than four feet across, which finally runs into the river Deveron

Opposite: In the light of an autumn morning a fisherman makes his first cast of the day at Grantown-on-Spey

Now used in more than 60 plants for treating sewage and industrial wastes, including 'difficult' effluent from the Pontypool works of ICI Fibres Ltd., 'Flocor' is efficient, cheap to run and costs less in both land and money to install than traditional filter-bed and other plants. It is light in weight, so that it can be easily packed and installed in modern towers, and needs little maintenance. This is why a 'Flocor' installation was chosen for the Tomatin Distillery, on the main road north from Speyside to Inverness. The largest malt whisky distillery in the world, with its output measured in thousands of gallons a week, and millions more maturing in its bonded stores under the strict control of resident Excise men, Tomatin takes water from, and discharges into, the Alt-na-Frith (or Free) Burn, which flows on to the Findhorn.

Like many other distilleries, it has increased its output enormously in recent years, both to meet demands for its own single-malt and blended whiskies and for sale to leading blenders of other brands. This would not have been possible without effective effluent treatment – and today, despite a daily flow of about 70,000 gallons of effluent, the discharge into the burn is well inside the limits set by the river purification board. The stream, once grossly polluted, runs clean and clear down to the river.

There are three stages in the 'Flocor' system, each made up of a tower packed 18 ft high with the pvc sections, and it gives an average purification efficiency of over 96 per cent. For Mr. John McDonald, manager at Tomatin, it also has other advantages. It occupies only a tiny area of land right alongside the burn; it is automated and so needs the attention of one man for only one-and-a-half hours a day; and even in the severe cold of Tomatin winter weather, more than 1000 feet above sea level, it has worked well as a filter for the Findhorn.

Another Mr. MacDonald, Ronald, manages the Ardmore distillery of William Teacher and Sons, Ltd., near Huntly in Aberdeenshire. There he produces much of the malt whisky used in blending his company's famous 'Highland Cream'. He too, has high praise for 'Flocor' as a filter medium.

'We have raised production steadily over the past few years – not long ago we doubled capacity by putting in two more pot-stills – so there has been a steady increase in the amount of effluent to be treated before it can be discharged into a local burn. We could have extended the existing conventional filter-beds, but instead we put in a two-stage 'Flocor' installation with a conventional filter as a final stage and it has exceeded all our expectations. The burn flows down to the river Bogie, which in turn joins the Deveron, so high efficiency is essential. We also benefit because the plant, which is some distance away, across a main railway-line, can be more or less left to run itself.'

Unlike Tomatin and Ardmore, where whisky has been made for many years, the Glenallachie Distillery Company's big distillery not far from Aberlour was opened only this year. It is settling into its first year of production, but already Mr. W. Delme-Evans, its designer and managing director, is pleased with the 'Flocor' installation almost hidden in a small valley nearby. Treated effluent goes into a burn running through this glen to the Spey at Aberlour, so high efficiency is essential. The compact design of the installation matches the modern buildings of the distillery, where only a handful of men control the whole whisky-making process.

Water conservation, and the need to control and reduce the pollution of rivers and other waterways, is getting more attention, in many more countries, than ever before. To meet higher standards, industrialists and local authorities are having to spend more on effluent treatment. And more are spending it on 'Flocor' installations, even though few of them make products so universally known as Scotch whisky, or discharge their wastes into rivers so lovely or important to fishermen as the Findhorn and the Spey.

ICI magazine

View from the office window—3. Looking out from the Head Office of ICI Norge A/S in Oslo towards the famous ski-jumping hill, Holmenkollen. In the opposite direction the view is down the Oslo Fjord. ICI Norge A/S has a turnover of around £3 million, and sells most of the major products of ICI Divisions, including dyestuffs, fibres, plastics and chemicals. The company employs about fifty people and operates a branch office in Bergen on the west coast.